



SECTION 714

ALUMINUM RAIL - TUBE TYPE

714.1 Description. This work shall consist of furnishing and erecting cast aluminum rail posts and extruded aluminum alloy tubes for railings on bridges, roadway medians and retaining walls.

714.2 Material.

714.2.1 All material shall conform to Division 1000, Materials Details, and specifically as follows:

Item	Section
Bearing Pads	1038.4
	Specification
Aluminum Alloy Extruded Tubes and Bars	ASTM B 221 Alloy 6061-T6*
Steel Bolts and Nuts	ASTM A 307
Aluminum Shims	ASTM B 209 Alloy 1100-0
Stainless Steel Screws and Washers	ASTM A 193 Austenitic Steel with minimum yield of 30,000 psi (207 MPa)
Stainless Steel Set Screws	ASTM A 276
Cast Aluminum Posts	ASTM B 108 Alloy 356.0-T6
High Strength Cast Aluminum Posts	ASTM B 108 Alloy A444.0-T4
End Caps	ASTM B 26 Alloy B443-F or ASTM B 108 Alloy B443-F

*Alloy 6063-T6 may be used for the 4-inch (100 mm) outside diameter by 1/8-inch (3 mm) thick bridge rail.

714.2.2 Two certified copies of mill and foundry test reports giving the typical chemical composition from ingot production and the specific mechanical properties of the tube and casting material shall be submitted to the engineer prior to any request for shop inspection, or prior to shipment to the project site for field inspection. The reports shall show the number of each heat involved, the quantity taken from each heat, and the project for which the material is being furnished.

714.2.3 Aluminum tubing for the horizontal members of the rail shall be extruded tubes of the size and shape shown on the plans. The tubes shall be uniform in quality and temper. Exterior and interior surfaces shall be smooth and free of laminations, cracks and other defects.

714.2.4 Anchor bolts, nuts and washers shall be of structural steel, galvanized in accordance with the requirements of AASHTO M 232, or they may be mechanically galvanized. If mechanically galvanized, the coating thickness, adherence and quality requirements shall conform to AASHTO M 232, Class C.

714.2.5 Material for insulating the bases of rail posts from concrete shall be an aluminum impregnated light colored caulking compound of the consistency of putty, or 1/8 inch (3 mm) thick bearing pads meeting the requirements of [Sec 1038.4](#).

714.3 Fabrication and Inspection.

714.3.1 Shop drawings of the rail and rail posts will be required, in general, as outlined in [Sec 712.3.2](#) for shop drawings for structural steel.

714.3.2 Fabrication of aluminum alloy material shall, in general, conform to or be equivalent to fabrication methods and practices recommended in the handbooks of the major producers of aluminum material and specifically to the following requirements:

- (a) Material shall be sawed, routed or milled. Flame cutting shall not be used.
- (b) Tubing may be heated to a temperature not exceeding 400 F (205 C) for a period not exceeding 15 minutes to facilitate bending. Bending shall be performed in the shop to the radius shown on the plans.
- (c) Holes in tubing shall be drilled. Holes in casting shall be cored, or drilled from the solid.
- (d) Welding will not be permitted except where specifically required by the specifications or on the plans. Welding shall be done by the inert gas shielded arc method using filler material meeting the requirements of AWS A5-10, Class ER5356 or ER5556.

714.3.3 Tubing for rails shall be fabricated in lengths of two or more rail panels. No special finish is required on tubing, but exterior surfaces shall be reasonably free from dark streaks or discoloration. End closures shall be made either with plates welded in place and ground smooth, or with cast end caps having a driving fit. Grinding marks shall be removed in the shop or field and the surface shall be left in a condition matching the tubing. The fabrication and handling of aluminum material in the shop and field shall be performed in a manner to prevent scoring or marring of the surfaces. Objectionable appearance resulting from scoring or marring will be cause for rejection.

714.3.4 The finishing of rail posts shall be performed after fabrication is completed. All fins, pipes, other casting irregularities, and all drilling, reaming, welding and other fabrication marks shall be removed. The surfaces shown on the plans shall be polished to not less than a 120 grit finish. Discoloration of the finished post will be cause for rejection.

714.3.5 Shop inspection of rail tubes will in most cases be waived, but the tubes will be subject to inspection at the project site. Shop inspection of rail posts will be made at the foundry to establish a satisfactory class of finish and acceptability of fabrication or, at the option of the engineer, one sample post from each lot or heat, or for each structure may be sent to the engineer for approval. If this post is acceptable, it will be delivered to the project site and used as a standard for the acceptance of the remaining posts required for that structure.

714.3.6 Quality Control for Molds. Permanent molds shall be used for rail post castings unless specific permission is obtained to use sand molds. Castings for both the ornamental type and the high strength rail posts shall be produced under 100 percent radiographic control

and shall be X-ray inspected until a foundry technique has been established for each mold which will ensure production of castings acceptably free from harmful defects.

714.3.7 Quality Control for High Strength Rail Posts.

714.3.7.1 After an acceptable foundry technique has been established, at least four posts from each lot shall be X-ray inspected for quality control. For each post failing to meet the X-ray requirements, two additional posts shall be X-ray inspected. If further rejections are encountered, the whole lot will be rejected, or each post shall be X-ray inspected. Areas to be inspected are the bottom 5 inches (125 mm) of tension and compression flanges, and the base of castings. One X-ray exposure representative of each of these three areas will be considered sufficient.

714.3.7.2 For high strength rail posts, a lot of castings shall consist of not more than 60 one-tube or 50 two-tube posts, or the castings produced from each batch of a batch-type furnace, or the castings produced during a period not exceeding eight consecutive hours from a continuous furnace. At least one representative sample of each lot of castings, or one for each structure, shall be analyzed to determine conformance with the requirements for the mechanical properties and chemical composition. Two certified copies of the foundry or testing laboratory's report shall be furnished the engineer.

714.3.7.3 Specimens for tensile tests shall be machined from the specified area of the tension flanges and all testing shall be performed in accordance with the requirements of Federal Standard 151A, Method 211.1 and shall be certified by the foundry or testing laboratory. The largest possible round specimen shall be used. Flat specimens shall be used only when the casting thickness will not permit the extraction of at least an R3 specimen. If any test specimen fails to meet the requirements, two additional specimens may be selected to replace each specimen which failed. The two replacement specimens shall meet the requirements or the lot of castings which they represent will be rejected.

714.3.7.4 Radiographic acceptance levels for critical areas shall be based on the requirements of ASTM E 155 and the following acceptance standards:

Type of Defect	Reference Radiograph Plate Designation	Acceptance Standard Casting Thickness	
		1/2 in. (13 mm) and under	Over 1/2 in. (13 mm)
Gas Holes	1.1	2	3
Gas Porosity (round)	1.21	3	2
Gas Porosity (elongated)	1.22	2	2
Shrinkage Cavity	2.1	2	-
Shrinkage (sponge)	2.2	2	2
Foreign Material (less dense)	3.11	3	3
Foreign Material (more dense)	3.12	2	1

NOTE: (1) Presence of one or more types of defects greater than indicated by the above acceptance standards shall be cause for rejection of the casting.

(2) Presence of defects equal to but not greater than shown in the acceptance standards shall be limited to a total of two each of all types of defects, or three of any one type.

Two copies of certifications that X-ray inspection has been performed and meets the requirements for each lot shall be furnished the engineer.

714.4 Construction Requirements.

714.4.1 Anchor bolts for rail posts shall be set with suitable templates in the specified position and securely fixed to prevent displacement during the concreting operations. The area of concrete upon which posts are to be set shall be dressed by grinding or rubbing to a true plane for the proper seating of the posts. The base of the rail posts shall be insulated from the concrete on which it is seated by the use of a bearing pad, or by a liberal coating of a caulking compound meeting the requirements of [Sec 714.2.5](#).

714.4.2 Rail posts shall be erected in groups corresponding to the length of each rail tube. The rail shall then be aligned and the nuts on the anchor bolts tightened. In final adjustment, no post shall deviate more than 1/8 inch (3 mm) from true alignment and there shall be no abrupt break in grade or alignment of the finished rail. Aluminum shims for adjustments may be slotted.

714.5 Method of Measurement. Measurement of aluminum rail will be made to the nearest linear foot (0.5 m) of rail for each structure, measured along the top of the parapet from end to end of tubing. Final measurement will not be made except for authorized changes during construction, or where appreciable errors are found in the contract quantity. The revision or correction will be computed and added to or deducted from the contract quantity.

714.6 Basis of Payment. The accepted quantity of aluminum tube-type bridge rail, complete in place, will be paid for at the unit price for each of the pay items included in the contract.